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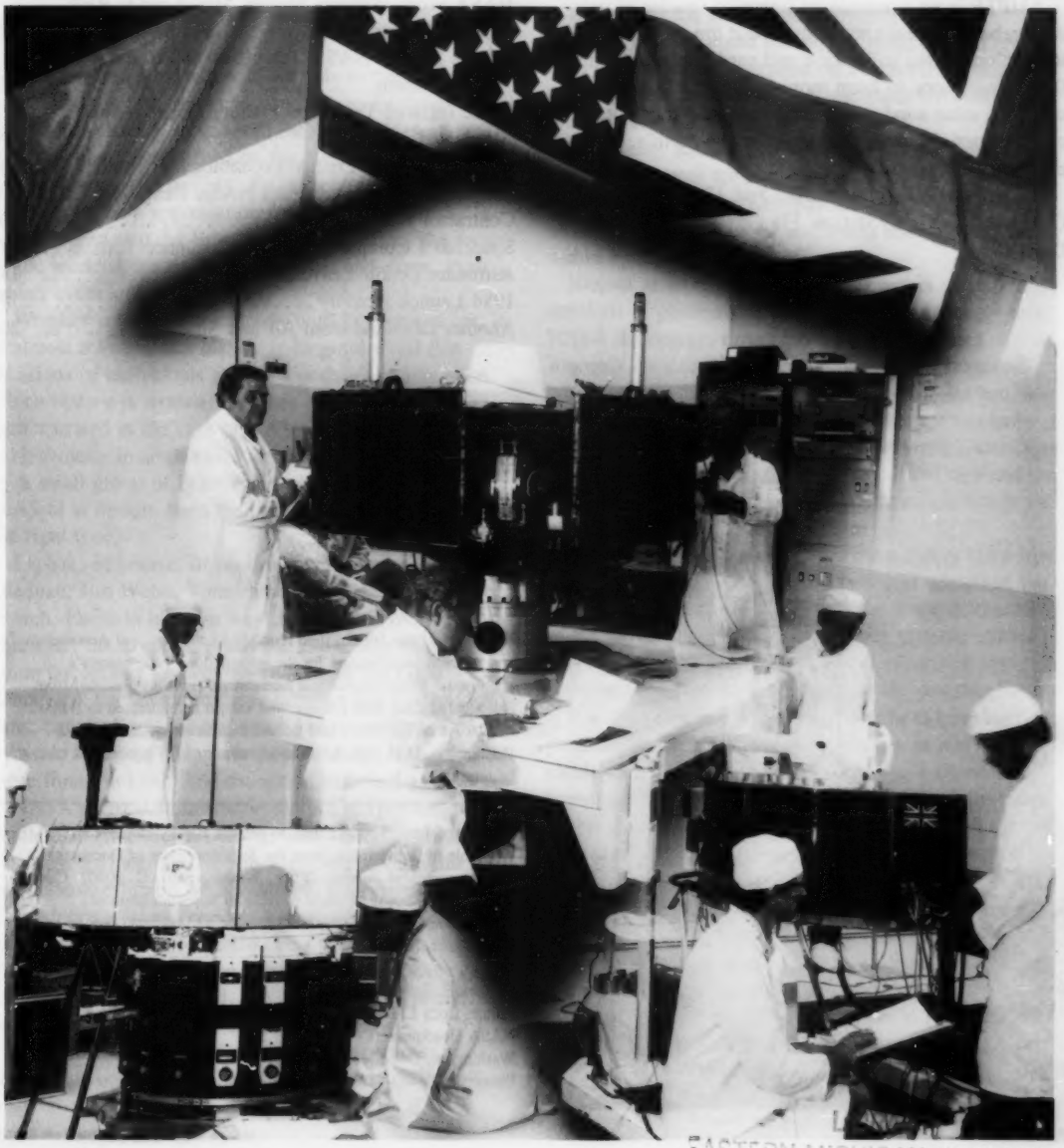

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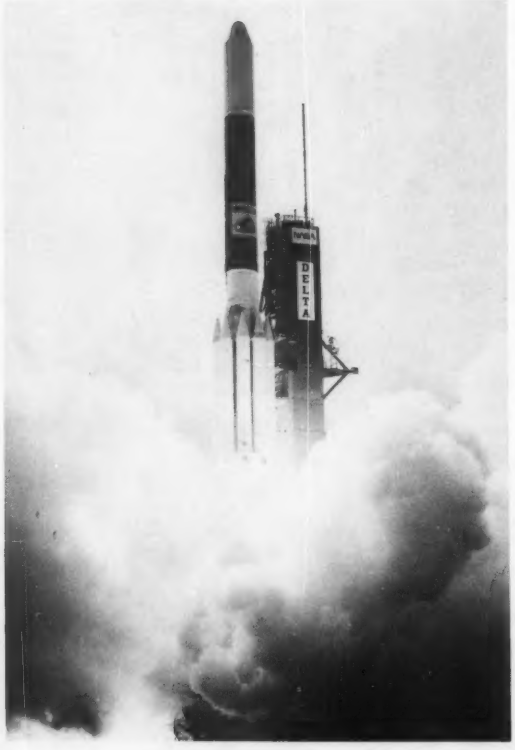
About the Cover

Framed by the flags of the nations participating in the international Active Magnetospheric Particle Tracer Explorer (AMPTE) mission, this collage of pictures shows the three spacecraft being tested in the Spacecraft Assembly and Encapsulation Facility at Kennedy Space Center, Fla.

Clockwise from the bottom left are the Ion Release Module (Federal Republic of Germany); Charged Composition Explorer (United States); and the United Kingdom Subsatellite (Great Britain).

AMPTE is an international scientific venture to gain comprehensive new knowledge about the physical interactions of the solar wind and earth's magnetic field. Researchers hope to learn more about what happens when the solar wind — a continuous stream of hot, charged particles from the sun — meets earth's envelope of magnetic force.

Below, AMPTE lifts off from Pad 17A at Cape Canaveral Air Force Station, Fla., on Aug. 16, aboard Delta 175.



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Administrator's Column

(In this column NASA Activities features an article by NASA Administrator James M. Beggs. These articles focus on subjects chosen by him that address topics of broad interest to the agency's employees. The column this month features an address presented at the opening of the NASA Administrators Exhibit on Aug. 15 at the Smithsonian Institution's National Air and Space Museum in Washington, D.C.)

A Salute to Architects of the Future

I see this exhibit as a tribute not only to those who have guided NASA over the years, but also to hundreds of thousands of others in government, universities and industry who have worked on the NASA programs for over a quarter of a century. So on behalf of all—let me express our deep appreciation for this high honor.

It has been said, by Emerson, I believe, that "the secret of the world is the tie between person and event. Person makes event and event person."

Whether you agree completely with Emerson or not, it is almost a truism that history *is* biography and that decisions of individuals are the foundation points upon which history is written. This has been amply demonstrated in the case of NASA, where our national achievements in aeronautics and space have been sparked by a small group of individuals who have, through accident or design, been the right men in the right jobs at the right time.

I speak, of course, of my five predecessors—Keith Glennan, Jim Webb, Tom Paine, Jim Fletcher and Bob Frosch. Each, in his own way, brought to NASA the character, the experience and the knowledge needed to guide the agency to meet the challenges the times demanded. Each built on the foundation laid by those who came before. Each demonstrated a keen perception of the dynamic forces of change in the world and responded to those forces in kind. And the nation benefited as a result.

NASA's first Administrator was Keith Glennan, a gentle man from North Dakota, with a solid grounding in electrical engineering. He was President of Case Institute of Technology and a former Atomic Energy Commissioner when President Eisenhower nominated him to head NASA in August 1958. That was a month after the President signed legislation establishing the agency, and ten months after Sputnik I, the world's first artificial satellite was launched by the Soviet Union.

It fell to Keith, a good manager and organizer, to consolidate under NASA the United States' civil space program, a program burgeoning with plans and opportunities, but still in its infant stage. Most important was the call from the public and our elected officials to get out in front of and stay ahead of the Russians.

Keith directed the integration under NASA of the government's major scientific and technical programs in aeronautics and space studies. He succeeded superbly and by the end of his tenure in 1961, NASA included not only the facilities and much of the staff of the old National Advisory Committee for Aeronautics, but those of the Advanced Research Project Agency, the Naval Research Laboratory and the Army Ballistic Missile Agency as well.

Keith gave the green light to Project Mercury, America's first manned spaceflight program, and under him, NASA began to expand on a broad front ranging from activities to measure the near-earth environment to solar system exploration.

Jim Webb, Keith's successor, moved the agency into high gear to meet the awesome national challenge proposed by President Kennedy on May 25, 1961: to land an American on the moon and return him safely to earth, within the decade of the 1960s.

Known as an aggressive manager within the top echelons of government and industry, Jim brought to NASA the energy, thrust and inspiration needed to succeed. As a student of government and a seasoned bureaucrat (in the best sense of that word)—he had been President Truman's Budget Bureau Director and had worked at high levels of the State Department under Dean Acheson—Jim moved vigorously to cut red tape and put the best minds of government, universities and industry to work on the project.

Jim was not only an energetic, but a highly innovative Administrator. He recognized that one of our great, but unrecognized, national assets was the research capability of the university community. He sought to strengthen that capability and to bring highly talented university scientists and engineers directly into the program.

For 7½ years Jim worked and fought to keep the program on track. His problem was not so much a recalcitrant Congress, because there was a sizeable consensus that supported the effort to be first on the moon. Rather, his major problem was organization: getting it all together—resources, talent, technology—to meet the national goal. In that, he succeeded magnificently. And, in October 1968, secure in the knowledge that it *would* be met, he retired from government service. He had brought America's space program from short-distance sub-ortital flights to the threshold of the moon. Two months later, during the Apollo 8 mission, man was to fly to the neighborhood of the moon for the first time.

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America had surged into the lead in space technology and applications, a lead we retain today.

Incidentally, and very typically, I understand that this exhibit was Jim's idea. When the Webb exhibit behind me was installed here in September 1982, Jim told Walter Boyne that he thought it should have a larger focus. As always, he was concerned with what he considered undue emphasis on himself. If he were here today, I know he would be pleased and proud that Walter took him up on that suggestion.

Jim's successor, Tom Paine, had been Jim's deputy and carried on in the Webb tradition. Solid corporate experience, engineering and scientific expertise and an electric and extroveted personality helped him do the job. Under Jim, he had learned how to work with the Congress, which was beginning to have doubts about spending money on the space program in the emotional climate generated by the Vietnam War. Nevertheless, even with budget cutbacks, under Tom's watch, the first seven Apollo manned missions were flown, in which 20 astronauts orbited the earth, fourteen traveled to the moon and four walked on its surface.

Tom's tenure, from 1968 to 1970, was a period of post-Apollo planing, a job for which he was well-suited. His corporate experience at General Electric and his association with Jim Webb had brought him into contact with a wider variety of scientists, engineers and Members of Congress. This broadened his vision and sharpened his pragmatism—two very valuable attributes in setting the agency's planning parameters.

Tom's successor, Jim Fletcher, a physicist and research scientist, carried the program forward during a period of lagging public enthusiasm for the space program, as the Vietnam War dragged on. A methodical and thorough man, Jim knew the program down to the minutest technical detail. As a result, he had a great deal of credibility in industry and government circles, especially with the Office of Management and Budget. Indeed, I believe it was that credibility that convinced OMB to allow the Shuttle program to move forward as fast as it did in the early and mid-1970's in the face of many competing national priorities.

Bob Frosch, NASA's fifth Administrator, had a background in oceanography, a good training ground for space, since both environments are inherently hostile to man and both are frontiers of the unknown. As an articulate scientist, Bob, too, had high credibility in both the scientific community and among the public. He was able to mobilize that credibility into renewed broad national support for the NASA program.

In an era of severe budgetary restraints, Bob managed to keep our major programs intact, even as the Shuttle moved into its final developmental phase.

I was fortunate to inherit the legacy of these five men, a legacy which spanned more than two decades of unprecedented American scientific and technical achievement.

Each was a man of the hour for his time and place. As the world changed, each was astute enough to recognize that government, industry and the scientific world must change with it. That has been one of the untold secrets of NASA's success over the years, and I am proud to carry on their work in that tradition.

NASA has been fortunate to have had such leaders, but the nation has been the real winner.

Thanks to their work, NASA has helped us build a scientific and technological base second to none. And as the American aerospace adventure continues, we are on course for even bolder accomplishments in the future.

Leadership can be described in many ways, but I prefer Walter Lippmann's definition. He wrote: "The final test of a leader is that he leaves behind him in other men the conviction and will to carry on."

By any measure of achievement, I believe NASA's past Administrators have passed that test with flying colors.

As one who is temporary custodian of all they built, I hope I've been up to the never-ending challange to walk well in their footsteps.

NASA Symposium on Productivity and Quality

NASA will conduct a symposium on productivity and quality on Sept. 25 and 26 in Washington, D.C. The goal of the symposium is to find strategies for improving operations in government and industry. The symposium is designed for decision makers in government, industry and academic institutions as a form of discussing approaches to increase effectiveness in their organizations.

NASA Administrator James M. Beggs has set the goal for NASA to become a national leader in productivity and quality improvement. Since it is recognized that NASA can accomplish this goal only with the support of the institutions it works with, the symposium will serve as a forum to focus on management issues involved in productivity initiatives and to those approaches successful organizations have used to increase their performance.

While productivity improvement and quality enhancement are not new goals to NASA or, for that matter, to other successful organizations, it has become alarmingly clear that the decline in productivity growth

since 1965 in the United States is of importance to all of us. As White House Conference on Productivity pointed out the relatively low rates of productivity growth for almost a decade have weakened our economic vitality, threatened our standard of living and our industrial competitiveness. For the last 10 years, the rate of productivity growth for the country has been lower than every major developed country, except Canada. Not only has Japan surpassed us, but also England, Italy and France have exceeded the productivity rate of the United States since 1965.

On Aug. 20, President Reagan sent his best wishes for a successful symposium stating:

> *"Productivity — the key to continued economic growth — is hard won, and harder still to maintain, for we are increasingly confronted with serious competition in the world market. How we meet these challenges will be the modern test of our grit, initiative, and boldness. Following the example of our forebears, we need to rely on basics, yet dare to dream, always remembering that there is no substitute for quality. Excellence must never be compromised."*

The objective of the symposium is to increase the awareness of productivity and quality issues in the United States, and to foster national initiatives through government and industry executive leadership.

The symposium will provide a forum for discussion of white-collar productivity issues by experienced executives from successful organizations and an opportunity to share information learned through productivity initiatives in government, industry and academic organizations. It will focus on white-collar organizational issues that are common to large companies and technology oriented organizations. The symposium program will include strategies for improving operations in government and industry and will be responsive to the management issues viewed necessary to increase our nation's productivity growth rate.

The symposium, sponsored by NASA and operated by the American Institute of Aeronautics and Astronautics, is supported and organized by key decision makers from government, industry and the academic community through steering groups for planning and implementation.

The symposium will be televised live on NASA closed circuit television and the video feed will be available to interested government agencies and other institutions for public dissemination.

Headquarters Personnel Announcements

Ann P. Bradley has been appointed to the newly revised position of Associate Deputy Administrator of NASA. Previously she had been Deputy Associate Administrator for Management.

Bradley began her career in 1973 as a personnel management specialist at NASA Headquarters. From September 1974 to June 1975, she was appointed a Princeton Fellow in Public Affairs and attended the Woodrow Wilson School at Princeton University, Princeton, N.J., through NASA's Executive Development Program. When she returned from Princeton in 1975, she became executive assistant to the Deputy Administrator of NASA. From 1976 to 1979 she was Director of Administration at Dryden Flight Research Center, Edwards, Calif. In August 1979, she was appointed Manager of the NASA Resident Office at the Jet Propulsion Laboratory, Pasadena, Calif., serving there until her appointment in April 1980 as the Deputy Associate Administrator for Management. Earlier this year, she participated in the Advanced Management Program at the Harvard Business School, Cambridge, Mass.

Prior to joining NASA, Bradley served in the U.S. Air Force and has worked for the Office of Economic Opportunity, the Agency for International Development and the Central Intelligence Agency in Washington, D.C.

Jesse W. Moore has been appointed Associate Administrator for Space Flight.

Moore had been serving as the Acting Associate Administrator for Space Flight since April 15, 1984. He was appointed Deputy Associate Administrator for Space Flight in February 1983.

Moore came to NASA Headquarters in 1978 as Deputy Director of the Solar Terrestrial Division in the Office of Space Science. In June 1979 he was appointed Director of the Space Flight Division. He became Director of Earth and Planetary Exploration Division in December 1981.

Prior to those assignments, Moore was employed at the Jet Propulsion Laboratory starting in 1966, and

worked in a variety of areas at JPL, including guidance and control, advanced programs, and flight projects. His last assignment at JPL was as Science and Mission Design Manager for Project Galileo. Moore graduated from the University of South Carolina in 1964 with a master's degree in Electrical Engineering. He joined General Dynamics immediately after graduation and worked in guidance systems development for naval missiles.

C. Robert Nysmith has been appointed Associate Administrator for Management at NASA Headquarters.

Nysmith had been serving as Assistant Associate Administrator for Management since January 1984. Prior to this, he served as Assistant Associate Administrator for Management Support in the Office of Aeronautics and Space Technology.

Nysmith began his career at NASA's Ames Research Center in Mountain View, Calif., in 1959 as a research scientist where he conducted research activities oriented toward advanced spacecraft structures and concepts. In 1971, he joined the staff of the Space Shuttle Technology Coordination Office and in 1972 was named chief of the office. In October 1973, he transferred to the Office of Aeronautics and Space Technology in Washington, D.C., to serve as technical assistant to the Associate Administrator.

NASA Flies Zero-G F-104 Flight Series for John Deere Iron Study

Gravity's effect on solidifying molten cast iron is being studed by John Deere and Co. with the help of a NASA TF-104G research aircraft at the agency's Ames Dryden Flight Research Facility, Edwards, Calif. The two-seater F-104 was flown in high altitude arcs to simulate weightlessness during the experiment. Each F-104 flight provided about 50 seconds of near zero-g ($\pm$ 0.03g) environment for the iron experiments.

Data gathered during these flights will be compared to experiments done in the normal 1-g environment on earth. John Deere is particularly interested in the variations that occur in the microstructure of commercial nodular iron. An understanding of the iron microstructure and its formation could lead to superior iron products such as engine blocks.

The NASA F-104 flight research team flew eight of the zero-g flights carrying a specially prepared experimental furnace crucible in a bay behind the NASA flight test engineer experiment operator. Each flight lasted about 23 minutes. The aircraft crews, a pilot and a flight test engineer for each mission were outfitted in pressure suits for the flights which flew to maximum altitudes of 74,500 feet. During each flight data was transmitted to a ground station at the Ames Dryden facility.

A typical test flight involved takeoff and a climb to 35,000 ft. during which the iron sample was being heated to 1,350 degrees Celsius (2,461 degrees Fahrenheit). This was followed by a three-g pull-up into a parabolic arc to 73,000 ft. During the low-g period at the top of the arc, the molten iron was cooled to solidification with helium gas. The pilot then recovered the aircraft from the dive segment of the arc at about 50,000 ft. Speeds during each flight ranged from Mach 1.9 at 30,000 ft., prior to pull-up, down to 140 knots (160 mph) at the top of the parabolic arc trajectory.

Preliminary results indicate a successful flight series according to Guy A. Smith of the University of Alabama in Huntsville, Ala. Smith, a research associate under contract to NASA's Marshall Space Flight Center in Huntsville, which administers the technical exchange agreement for the research between NASA and John Deere and Co., says that, even though the F104 flights are of short duration compared to later iron research to follow on the Space Shuttle, they offer considerable economy and flexibility to the experimenter. An experiment package can be adjusted or repaired and readied for another flight within hours. This makes the F-104 zero-g flight test method well suited to preliminary test work where many variables may occur.

Flying the high altitude low-g research flights were Dryden test pilots Rogers Smith and Ed Schneider with flight test engineers Vic Horton and Ray Young.

Other metal experiments have been flown with the F-104 zero-g program. Dryden assisted the Swedish Space Corp., a state-owned entity, in research concerning new forms of aluminum alloys in early 1982.

Laser Technology Used to Improve Aircraft Design

NASA scientists have developed a Long Range Laser Velocimeter that measures speed and direction of air flow about an aircraft more precisely than ever before. The instrument will be used in wind tunnel research to help improve aircraft performance and fuel efficiency.

The laser device provides more complete aerodynamic data than was previously possible. Its detailed measurements of engine intake and exhaust flow patterns, aircraft wake plumes, wing flow vortices and overall air flow separation from the aircraft will help improve aeronautical propulsion and aerodynamic systems and reduce noise and drag.

Designed and developed at NASA's Ames Research Center in Mountain View, Calif., by Kenneth Orloff, Michael Reinath and Phillip Snyder, the laser device can handle tasks that have provided serious problems for previous instruments, such as measuring air flow in areas with complex turbulence patterns or in which the major flow direction is not known.

The Long Range Laser Velocimeter can be adjusted to meet the demands of a wide variety of tests, whereas older devices were often created for a single test and dismantled afterwards. It eliminates the cost of constructing new instruments for each new test.

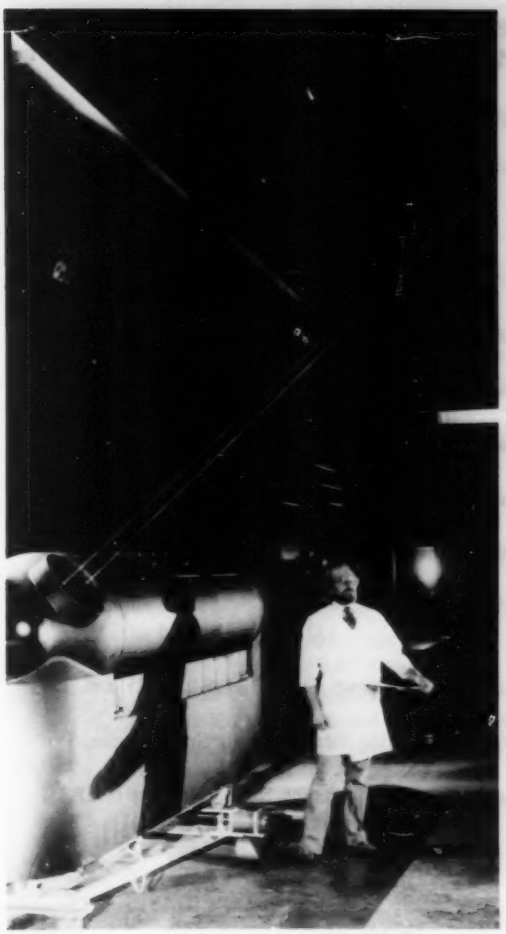
The velocimeter's two converging laser beams are computer-controlled. The beams may be rotated and raised or lowered to change the orientation of the measurement area. In this way the instrument is able to test detailed aircraft parts separately.

Where the laser beams converge, the speed and direction of particles moving through the air is measured by the light they reflect. This light is converted into an electrical current pattern and is then graphically displayed on a computer screen.

The frequency of the current displayed on the screen tells the speed and direction of the flow in the area where the laser beams intersect.

This area is elliptical in shape and only 0.4 inches long and 0.01 inches wide. Since this area is so small, the laser tool must make a large number of measurements to cover a typical test area. The machine's computer processes these hundreds of calculations almost instantly.

Accurate measurements can be made as far as 60 feet from the body of the instrument for measuring flow in the wake of a large aircraft. For measuring air flow in the vicinity of smaller objects, such as propellers, the beams may be focussed as close as 7.5 ft. away.



Co-designer Michael Reinath monitors operation of the Long Range Laser Velocimeter in wind tunnel at Ames Research Center.

The instruments used in the past also have tended to interfere with air flow, since they had to be placed directly in the area being measured. The new velocimeter, housed in a streamlined shell, can be moved on rails, so that it is well out of the way of the air flow being measured. Only the light beams are at the measurement location.

Shuttle Mission 41-G — Pre-Launch Statistics

Crew: Robert L. Crippen, Commander
Jon A. McBride, Pilot
Kathryn D. Sullivan, Mission Specialist
Sally K. Ride, Mission Specialist
David D. Leestma, Mission Specialist
Marc Garneau, Payload Specialist
Paul D. Scully-Power, Payload Specialist

Orbiter: Challenger (OV-099)

Launch Site: Kennedy Space Center, Fla., Pad 39A

Launch Date/Time: Oct. 5, 1984; 7:03 a.m. EDT*

Orbital Inclination: 57 degrees

Altitude: 190 nautical miles

Mission Duration: 8 days, 5 hours, 22 minutes MET*
132 full orbits; land on 133rd

Landing Date/Time: Oct. 13, 1984; 12:25 p.m. EDT*

Primary Landing Site: Kennedy Space Center, Fla.

Payloads: Earth Radiation Budget Satellite (ERBS)
Shuttle Radar Laboratory (SRL-1)
Large Format Camera
Orbiter Refueling System
Eight Getaway Specials (GAS)
IMAX

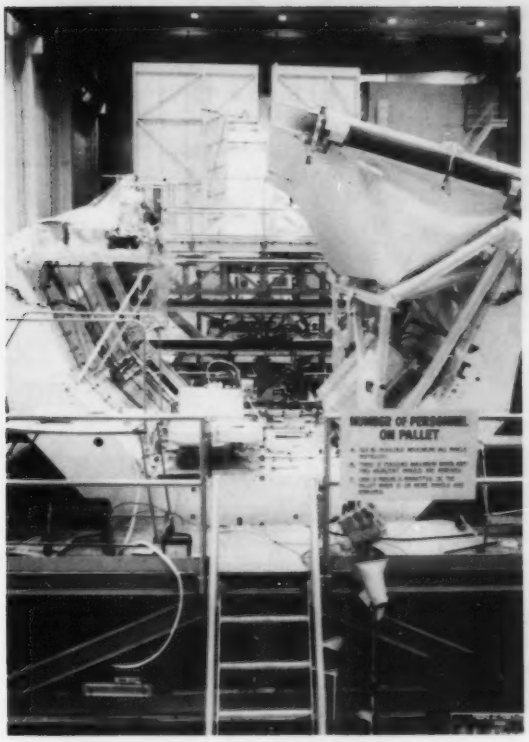
* Subject to change; mission elapsed times are approximate.

41-G crew (bottom row, from the left): Jon A. McBride, pilot; and mission specialists Sally K. Ride, Kathryn D. Sullivan and David C. Leestma. Top row, Paul D. Scully-Power, U.S. Navy civilian payload specialist; Robert L. Crippen, commander; and Marc Garneau, Canadian payload specialist.

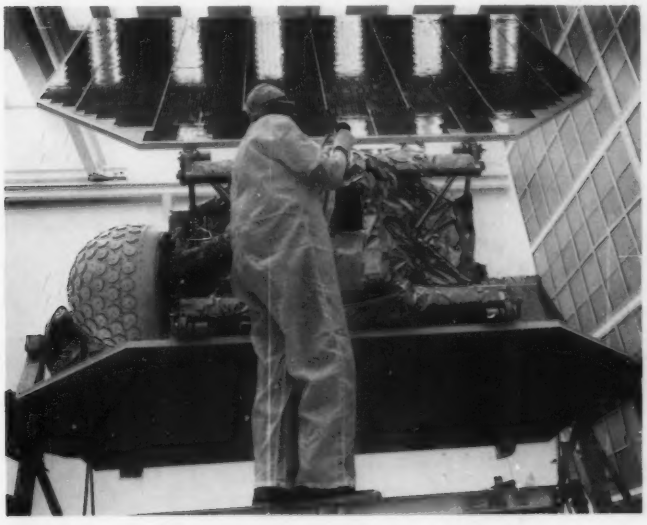
Experiments: Auroral Photography Experiment (APE)
Canadian Experiments (CANEX)
Evaluation of Oxygen Interaction With Materials (EOIM)
Radiation Monitoring Experiment (RME)

Mission Firsts: First seven-person crew
First Canadian Payload specialist
First American woman to perform an EVA
First use of Orbiter Refueling System
First flight of the Large Format Camera

Principal Mission Activity: The **Earth Radiation Budget Satellite** (ERBS), a low cost, free-flying satellite, is designed to study the earth radiation budget and measure stratospheric aerosols and trace elements. At an altitude of approximately 190 nautical miles, the crew will release ERBS from the payload bay using the Payload Data and Retrieval System, and maneuver away from the satellite. A hydrazine propulsion system will boost ERBS to an altitude of approximately 325 n.mi. Data gathered by ERBS is expected to aid in predicting climatic conditions on earth in relation to its environmental quality.



The Shuttle Radar Laboratory is shown in test stand in high bay of the Operations and Checkout Facility. Below, an engineer looks on as one of the two large solar arrays on the Earth Radiation Budget Satellite is extended during preflight testing.



The **Shuttle Radar Laboratory** (SRL-1) is essentially a reflight of OSTA-1 flown on STS-2. Modifications have been made to the same experiment packages that flew as OSTA-1 in order to facilitate more advanced data gathering. Experiments to be flown are earth viewing experiments including the Shuttle Imaging Radar (SIR-B), Feature Identification and Location Experiment (FILE) and the Measurement of Atmospheric Pollution from Satellites (MAPS). SRL-1 experiment hardware is configured on a pallet, attached in the payload bay.

The **Large Format Camera** (LFC), located on a Mission Peculiar Experiment Support Structure (MPESS) in the payload bay, will remain attached. The LFC will acquire data to be used in evaluation of mapping and earth resources applications of metric photography from space. The LFC features a film format of 9 × 18 inches, a focal length of 12 inches and a thinbase film capacity of 4,400 feet (approximately 2,400 frames). The LFC will be controlled by the ground throughout the flight.

The **Orbiter Refueling System** (ORS), an experiment designed to demonstrate the capability on on-orbit satellite refueling by the STS, will involve four hydrazine transfers during the mission. The ORS payload is mounted on a MPESS with the Large Format Camera in the payload bay. The ORS operations on this flight will include an EVA by Mission Specialists Kathryn Sullivan and David Leestma to demonstrate an EVA tool/valve interface which would allow the servicing of existing satellites.

The **Auroral Photography Experiment** (APE), sponsored by the U.S. Air Force, is intended to record various frequencies of auroral light. A standard Nikon 35mm camera (Fl.2/50mm lens) will be used with

seven different filters and a photon enhancing image intensifier to photograph the northern lights as encountered by the orbiter on this high inclination flight. APE data takes will be scheduled for night time passes at the northern orbital node. Photos will also be made of orbital OMS pods and vertical stabilizer to record any possible glow effects on orbiter surfaces caused by increased electron flow across those surfaces.

The **Canadian Experiment** (CANEX), provided by the National Research Council of Canada, consists of experiments in five basic disciplines: Space Adaptation Syndrome Supplementary Experiments (SASSE), Orbiter Glow Studies (OGLOW), Advanced Composite Materials Exposure (ACOMEX), Space Vision System Experiment Development Tests (VISET), and Sun Photometer Earth Atmospheric Measurements (SPEAM). Marc Garneau, Canadian payload specialist, will perform the CANEX experiment tasks.

The **Evaluation of Oxygen Interaction with Materials** (EOIM) experiment is a repeat of that flown on STS-8. The purpose is to obtain quantitative rates of oxygen interaction with organic materials on the orbiter and payloads. Hardware includes a thermal controlled experiment materials tray mounted in the payload bay, and a heater power control switch on the aft flight deck.

The **Radiation Monitor Experiment** (RME) will measure radiation levels in the orbiter's middeck. RME hardware includes the Handheld Radiation Monitor and Pocket REM Meter.

Oceanography — Operating Linhof and Hasselblad cameras, Paul D. Scully-Power, civilian oceanographer from the U.S. Navy's Underwater Systems Laboratory in New London, Conn., will take advantage of this high inclination flight to study and photograph the oceans of the world.

Summary of Major Activities

Flight Day 1
Earth Radiation Budget Satellite (ERBS) deployment
Orbiter Refueling System (ORS) powerup
Shuttle Rader Laboratory (SRL-1) operations
Getaway Special (GAS) activities

Flight Day 2
ORS hydrazine transfer
SRL-1 operations
Canadian Experiment (CANEX) activities
Radiation Monitor Experiment (RME)
GAS activities

Flight Day 3
ORS hydrazine transfer
SRL-1 operations
RME activities
GAS activities

Flight Day 4
SRL-1 operations
Evaluation of Oxygen Interaction With Materials (EOIM)
CANEX activities
GAS activities

Flight Day 5
ORS extravehicular activity
SRL-1 operations
GAS activities

Flight Day 6
ORS hydrazine transfer
SRL-1 operations
RME activities
GAS activities

Flight Day 7
ORS hydrazine transfer
SRL-1 operations
RME activities
CANEX activities
GAS activities

Flight Day 8
Crew Press Conference
RME activities
ORS deactivation
GAS activities

Flight Day 9
Landing at KSC

NASA Technology Transmitted to Schools Via Television

Transferring knowledge directly from NASA to classrooms across the nation in hours, rather than the years it can take to publish a new textbook, is what an educational television series from NASA's Lewis Research Center in Cleveland is all about.

A nationally circulated "electronic publication via satellite" project begins its sixth year this week. It is a joint effort of the Lewis Center and the Southern Educational Communications Association (SECA), in Columbia, S.C.

Under the agreement, the Lewis Research Center provides a half hour educational television program to SECA weekly. The material deals with space travel, space exploration and space science — subjects which capture the attention of children. Lesson guides, also produced and provided by NASA, help translate the learning experience to academic achievement, especially in science and mathematics.

In turn, SECA distributes the television program via the Westar IV satellite.

SECA's membership includes some 150 educational/public television stations across the Southland, from Maryland to Texas. SECA also transmits programs via the Westar IV satellite to stations and schools across the country numbering literally in the thousands. SECA mails advance information describing the program to public instructional TV program directors nationwide. The latter, in turn, forward that information to educators at school receiving sites.

According to Dr. Curtis M. Graves, NASA Director of Educational Services, "It is difficult to estimate exactly how many thousands of schools in the United States actually access the programs, but in Fresno County, Calif., alone, as many as 200 schools report they are using these satellite-fed materials."

Since the programming began in 1979, four series of 13 half-hour programs have been created at Lewis Research Center and distributed through SECA. The broad title for these programs is "NASA at Work" and series titles include "History of Space Travel," with updated material, which traces America's history of space flight from rocket pioneer Dr. Robert Goddard through America's first reusable spaceship, the Space Shuttle.

Other titles in the series to date are "Journey Through the Solar System," chronicling knowledge gained in recent years about the sun, the planets, asteriods and comets, and "Life in the Universe," about manned flight, survival in space and other space-related subjects.

The newest title is "Twenty-Five Years of Progress," documenting a busy quarter century of NASA air and space research and exploration.

Special television programs augment the series offering from time to time. An example is the just-released "Visions of Other Worlds," a production combining science fiction and science fact about the work of 27 artists.

A 13-part series being produced now for coming distribution is "The Airplane and NASA." It will depict early U.S. aviation progress and trace NASA's aeronautical research through the years.

A series in the planning stage will highlight numerous space engineering spinoff products and technology transfers that have emerged from the commercial reapplication of technology developed for NASA space and aviation programs.

Palapa B-2 Satellite Retrieval Planned

NASA will retrieve the Palapa B-2 spacecraft and return it to earth on the Space Shuttle under the terms of an agreement between the space agency and two insurance organizations — Merrett Syndicates Ltd. and International Technology Underwriters (Intec). The two companies represent the majority of domestic and foreign insurance underwriters that wish to retrieve the communications satellite.

The spacecraft was launched for the government of Indonesia on the 41-B Shuttle mission Feb. 6, 1984, but did not achieve the proper transfer orbit when the perigee kick motor failed.

The agreement, signed Aug. 13, calls for NASA to retrieve the satellite on the 51-A Shuttle mission currently scheduled for launch Nov. 2. The insurance underwriters will pay NASA for costs incurred in preparing for and executing the retrieval not to exceed $4.8 million.

The details of the rescue plan will be stated in a standard Shuttle Launch Services Agreement which all the parties will sign in the near future. This agreement could include a commitment to relaunch the satellite in July 1985, should the underwriters request it.

The spacecraft was built by Hughes Communications International, Inc., Los Angeles.

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NASA Work-Platform Studies May Lead To Real Space Construction

Astronaut construction crews may build large structures in space some day because of a program at NASA's Langley Research Center, Hampton, Va.

Recent tests indicate that a structural assembly concept developed at Langley — an assembly fixture called the Swing-Arm Beam Erector (SABER) — may be effective for space construction. SABER combines the mechanical advantage of a machine with the intellect, dexterity and versatility of a human.

The natural buoyancy simulator, a water tank 40 feet wide and 70 feet deep located at NASA's Marshall Space Flight Center, Huntsville, Ala., was used for the Langley tests of SABER. Neutral buoyancy is achieved when an object submerged in water neither floats nor sinks. This provides a method to simulate on earth the "weightless" effect encountered in space flight.

To support space missions that will require large structures, researchers in Langley's Structural Concepts Branch began investigating orbital assembly methods about 10 years ago.

"We began by manually assembling simple truss structures in the neutral buoyancy simulator," Judith J. Watson, project engineer, explained. "No machines were used to assist the test subjects. They had to manually move themselves and their building material from one end of the structure to the other to put it together. We quickly found that this was not an efficient way to build large structures in space because such maneuvers in space suits are fatiguing to the astronauts and lead to long construction times."

A machine-assisted astronaut assembly concept, involving two test subjects working together to build a truss structure in the form of a long beam, was then developed and tested in 1981 by Langley researchers. The test subjects — "astronauts" — stood on mobile work-platforms, which carried them and the construction material along the beam as it was constructed. The truss was built in sections called bays. When a bay was completed, it was moved out of the work area by a conveyor to allow further construction to continue.

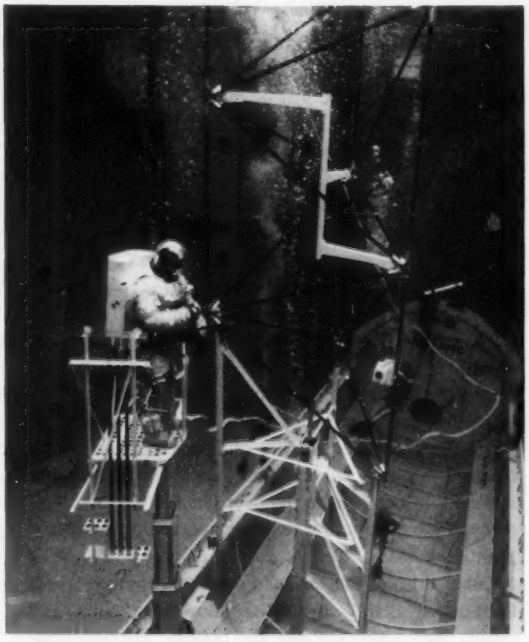
As an outgrowth of these studies, SABER was devised as a mechanized, one person station to assemble long beam-like trusses in space. The SABER assembly fixture consists of a work platform that supports the astronaut. The platform moves around the axis of the structure under construction on a swing-arm and along the axis of the structure on a telescoping pedestal. Thus the astronaut can be moved to any position required to build the structure. A central feed post lifts the completed section of the structure away from the work area.

"The beam is assembled one bay at a time on a telescoping fixture," explained Watson. "When one bay is completed, the fixture moves that section along the guide rails so that the next adjacent bay can be assembled. Bays can be continually assembled until the required beam length is constructed."

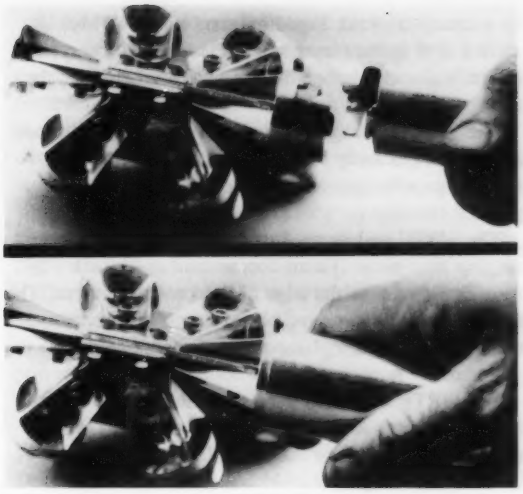
The operation of the work station and construction procedures and times were checked out in earth gravity (1-G) tests at Langley and in simulated weightlessness in Marshall's neutral buoyancy simulator where the "astronauts" wore scuba gear and Skylab space suits. The SABER was tested in a Space Shuttle cargo bay mockup at Marshall.

The time to construct the truss in neutral buoyancy was compared with the 1-G time. Watson said water drag had little effect on construction time. "The construction times we got wearing the pressurized space suits were the times we used to estimate how long it would take to build the structure in space. It takes us about 14 minutes to assemble a three-bay truss 17-feet long.

"Working and moving underwater in pressurized space suits and the astronauts' ability to work with the struts are definite time factors in the beam-building



Swing-Arm Beam Erector (SABER) is tested underwater in neutral buoyancy simulator.



The quick-attachment joint fitting is used to interconnect tubular struts in assembling long beam-like trusses. In the top portion of the photograph, the sleeve of the strut is pulled back, revealing the lock or connecting end joint. The lower portion shows the sleeve snapped over the joint fitting to secure the joints.

procedures," she said, "but there is no way around the suits' bulkiness or added weights. The test subject must be a self-contained unit, like an astronaut would be in space, and weights must be usd to achieve neutral buoyancy, simulating weightlessness."

Five consecutive assemblies of a three-bay beam in one simulated extravehicular activity (EVA) were performed by a pressure-suited "astronaut" in the simulator. Only three bays could be assembled at a time and still maintain total submersion of the structure. The total amount of structure assembled was equivalent to an 85-foot, 15-bay beam consisting of 150 struts and 48 joints. The simulated EVA lasted 1 hour, 44 minutes, including four 10-minute rest periods required for disassembly of the structure by scuba divers after each three-bay assembly. Watson said that, using this procedure, productivity reduction due to astronaut fatigue was not a factor within the limits of the data obtained during the tests.

The SABER tests give better insight into the feasibility and benefits of machine-assisted astronaut assembly of large space structures. Langley researchers are using results from the test program to develop a Shuttle flight experiment scheduled for launch in May 1985. The experiment is called Assembly Concept for Construction of Erectable Space Structure (ACCESS) and will validate neutral buoyancy simulator time and motion data and increase NASA's knowledge of the work station's value to EVA construction of space structures.

The SABER concept was devised by Walter L. Heard Jr. of the Structural Concepts Branch at Langley. The hardware was designed by Kermit Jenson, Kentron International, Hampton Va., and built in Langley's Metals Technology Development Section by Bertrand E. Fullerton and Richard K. Stoops.

What's New in NASA Television and Radio Programming

Programs released in August:

Television

Aeronautics & Space Report (4½-minute and 90-second versions):

The Model Builders

Radio

Space Story (4½-minute programs):

The Return of Solar Max (featuring Dr. Bruce Woodgate, Goddard Space Flight Center)

A Space Station for Science (featuring Dr. Robert Jastrow, Dartmouth University)

The Flight of Discovery (featuring Jesse Moore, NASA Associate Administrator for Space Flight)

Space Nets for Fishing (featuring Bill Kirkland, West Coast Netting)

Special Report (14½-minute program):

The Flight of Discovery (featuring Jesse Moore)

Copies of television tapes are sent simultaneously to all NASA Visitor Information Centers and Public Affairs Offices, and to 650 television stations nationwide as well as to 425 cable television systems via the satellite RCA-Cablenet 1. Five hundred television stations receive material formatted as a 4½-minute program; the remaining 150 stations receive a 90-second "spot" — a condensed version of the 4½-minute presentation.

NASA's radio programs are sent to approximately 3,500 radio stations across the nation; in addition, translations of the recordings are made by Voice of America and Radio Free Europe and these tapes are then released to the appropriate audiences overseas. Release each month are one report of 14½-minutes and four 4½-minute weekly stories (one story in the set is featured for one week of the month). Ten one-minute space notes are released quarterly.

Space Infrared Telescope Facility Investigators Selected

NASA has selected the scientists who will form the Science Working Group (SWG) for the Space Infrared Telescope Facility (SIRTF), the next generation earth-orbiting observatory for infrared astronomy.

The scientists were selected following a review of proposals solicited from the scientific community in 1983. Investigators were sought in several different categories — focal plane instrument investigators, facility scientists and interdisciplinary scientists.

The SWG principal investigators selected by NASA are: Dr. James Houck, Cornell University, Ithaca, N.Y.: infrared spectrometer instrument (focal plane investigation); Dr. Giovanni Fazio, Smithsonian Astrophysical Observatory, Cambridge, Mass.: wide field camera instrument (focal investigation); Dr. George Rieke, University of Arizona, Tuscon: multiband imaging photometer instrument (focal plane investigation); Dr. Frank Low, University of Arizona, Tucson: facility scientist; Dr. Edward Wright, University of California at Los Angeles: interdisciplinary scientist; Dr. Michael Jura, University of California at Los Angeles; interdisciplinary scientist.

The SWG includes the above principal investigators plus the project scientist, Dr. Michael Werner, the deputy project scientist, Dr. Fred Witteborn, both at NASA's Ames Research Center in Mountain View, Calif.; and the program scientist, Dr. Nancy Boggess, NASA Headquarters, Washington, D.C. Dr. Werner chairs the SWG. NASA's Ames Research Center has been assigned project responsibility for the SIRTF.

The SWG, in concert with the Ames project team, will now help guide the detailed definition studies for the observatory and the instruments.

The SIRTF mission has a high scientific priority within NASA and within the astrophysics and astronomy communities. According to Dr. Burton Edelson, NASA Associate Administrator for Space Science and Applications, the SIRTF is planned for a 1988 new start. "As the discoveries of the IRAS mission have shown us, the field of infrared astronomy is a very rich area for scientific discovery. We have great confidence that the SIRTF will produce great science by following up on these important discoveries," Dr. Edelson said.

Because the SIRTF is designed to detect light in the infrared region of the electromagnetic spectrum, it must be cooled to minimize the amount of infrared (heat) radiation emitted by the telescope itself. The optics and interior surfaces of the SIRTF will be cooled to a few degrees above absolute zero (–459 degrees Fahrenheit) by a cryogenic fluid, liquid helium, which will be carried aloft in the observatory. Placing the observatory in space also eliminates the infrared radiation from the earth's atmosphere.

The reduced background infrared radiation will permit astronomers to study much fainter and more distant infrared sources than can be detected from any other planned facility.

The SIRTF will be used to study a variety of objects ranging from solar system dust around nearby stars to forming galaxies at the edge of the known universe. The SIRTF's sensitive infrared observations will advance our understanding of many important astronomical problems.

The SIRTF will build upon the results of the recently expired Infrared Astronomical Satellite (IRAS), which successfully carried out the first all-sky survey at infrared wavelengths.

During its 300 days of operations, IRAS made many discoveries, including seven comets, a ring of solid material around the star Vega and bands of dust around the sun between the orbits of Mars and Jupiter.

The SIRTF will be about 1000 times more sensitive than IRAS and study a range of infrared wavelengths which extends almost ten times in each direction (both shorter and longer) that observed by IRAS. The spectral resolution — the ability the discriminate very fine "color" — achievable from the SIRTF will be between 100 and 1000 times that of IRAS. The SIRTF will also have much greater capability for providing images of infrared sources with fine spatial detail.

The SIRTF will be planned for maintenance in orbit. The orbital placement of the SIRTF, either in a high earth orbit as with the IRAS, or on a space station platform, will be among the questions examined by the SWG. The replenishment of the superfluid helium which cools the instrument and observatory will be a human-tended maintenance function.

NASA Transfers Energy Technology To Sohio

NASA and the Standard Oil Co., Ohio (Sohio), have completed a licensing agreement to transfer technology for a unique electrical energy storage system that could ultimately reduce the cost of electricity. Under the agreement, technology developed by NASA's Lewis Research Center in Cleveland has been obtained by Sohio for further development and possible commercialization.

The new technology involves an electrochemical system of large batteries capable of storing and discharging electricity. Theoretically, electric utility companies could use such a system to store energy produced during low demand periods for later use during periods of maximum power consumption. This would reduce the cost of electricity by reducing the need for expensive peak-generating equipment or new power plants, and by allowing greater utilization of the most efficient generating equipment now in place.

The battery may also be used by large industrial or commercial customers to reduce peak energy demand or in conjunction with solar or wind-power systems so that power could be provided in the absence of sunlight or wind.

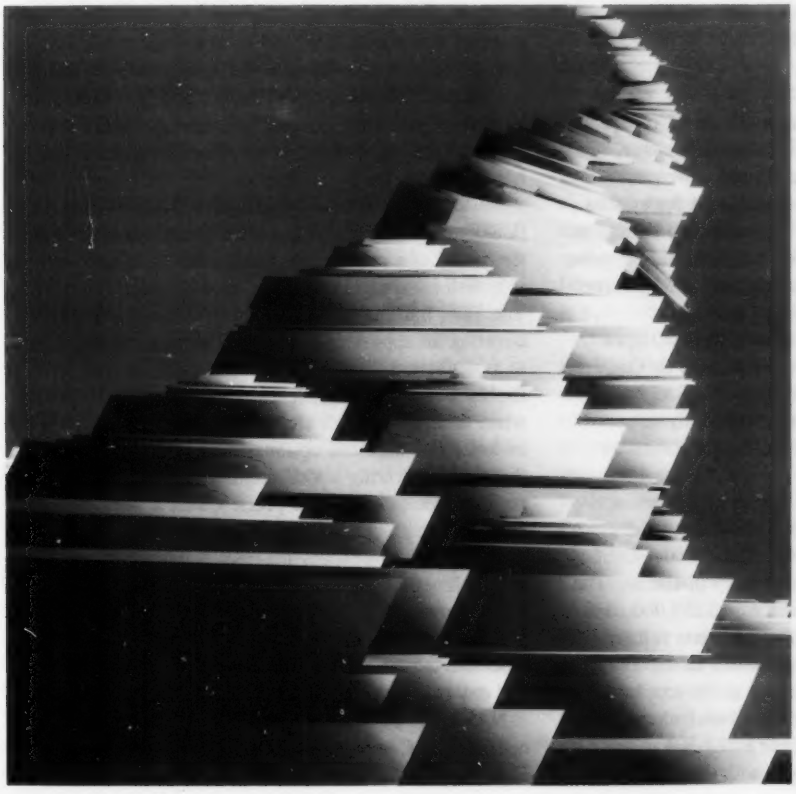
The system was developed at Lewis over the past 10 years under a program jointly funded by the U.S. Department of Energy and NASA.

"Although additional basic research and development work will be required, Sohio believes this technology may help to reduce America's energy costs at some point in the future," said Dr. Glenn R. Brown, Sohio's vice president of technology and planning. "We are particularly optimistic about its potential compared to conventional lead-acid battery storage systems. This system is expected to have a much longer life and be cheaper to build and maintain."

"The agreement with Sohio reflects continuing efforts by NASA to help transfer aerospace technology to private industry for appropriate commercial development," according to Andrew J. Stofan, Lewis Center Director. "Successful technology transfer provides substantial benefits to the nation's economy and people."

The original idea for the energy storage system was conceived and the technology developed by a team under Dr. Lawrence H. Thaller, now chief of the Electrochemistry Branch, Space Power Technology Division, at Lewis.

Sohio's battery research is being conducted at the company's research and development center in Warrensville Heights, Ohio.



"Infinity Tower" — an acrylic on canvas by James Cunningham. As orbiter Challenger (Shuttle mission 41-C) is launched on April 6, 1984, a giant illusionary cloud column traces humanities' path into space. From launch Pad 39A, miles into the sky, the Space Shuttle's exhaust column mirrors nature's clouds and thunderheads, giving raw material for one's imagination to build castles in the air. In this painting, the exhaust column is constructed of regular geometric forms and colored by the myriad hues of the Florida coast.

Patents for Inventions from NASA Research

The Office of General Counsel, NASA Headquarters, announces the following U.S. patents have been issued by the U.S. Patent Office and Trademark Office to NASA for inventions resulting from NASA research. Inquiries concerning them should be directed to the attention of the NASA Patent Counsel of the indicated installation.

Inventor(s) & Employer	Title	Patent No.	Installation
Clifford M. Siegel, Caltech/JPL, Pasadena, Calif.	Expitaxial thinning process	4,462,871	NRO/JPL
Peter F. MacDoran, Caltech/JPL, Pasadena, Calif.	Method and apparatus for calibrating the ionosphere and application to surveillance of geophysical events	4,463,357	NRO/JPL
John A. Parker, Demetrius A. Kourtides, NASA/ARC	Fire blocking systems for aircraft seat cushions	4,463,465	ARC
Robert P. Gruber, NASA/LeRC	Simplified D.C. to D.C. converter	4,464,710	LeRC
Martin B. Barmatz, Caltech/JPL, Pasadena, Calif.	High temperature acoustic levitator	4,463,606	NRO/JPL
James S. Sovey, Vincent K. Rawlin, Robert F. Roman, NASA/LeRC	Ring-cusp ion thruster with shell anode	4,466,242	LeRC
Richard J. Stein, Robert E. Pease, NASA/MSFC; Peter D. Poulson, Adjunct Systems, Inc., Huntsville, Ala.	Longwall shearer tracking system	4,466,667	MSFC

Contractor News

NASA has selected **LTV Aerospace and Defense Co.,** Dallas; **Martin Marietta Denver Aerospace,** Denver, Colo.; and **TRW, Inc.,** Redondo Beach, Calif., for negotiations leading to contracts for system definition studies for an Orbital Maneuvering Vehicle to ferry satellite about in space. The combined dollar value of the fixed-price contracts is approximately $5 million. The contracts will be negotiated and managed by Marshall Space Flight Center, Huntsville, Ala. Upon approval to proceed with the construction of an OMV, proposed for a first launch about 1990, NASA anticipates that one of the companies from those involved in the definition studies would be chosen to build the flight hardware.

Marshall Space Flight Center has awarded contracts to **Ford Aerospace Corp.,** Palo Alto, Calif., and **Lockheed Missiles and Space Co.,** Sunnyvale, Calif., for the conceptual study of geostationary platforms. The contracts, each valued at approximately $550,000, will run for a period of 21 months. The contracts call for Ford and Lockheed to envision platforms of the 1990s and to report their findings to NASA at the conclusion of the studies. The platforms would revolve above the equator at the geostationary altitude of 22,300 miles, where they would be synchronized with the earth's rotation and would appear to remain fixed in the sky. The platforms could serve a variety of uses, including communications, earth observations and data collection. At the geostationary altitude, instruments aboard such a platform could continuously monitor almost an entire hemisphere at once.

NASA has selected **United Space Boosters, Inc.** (USBI) of Hunstville, Ala., for negotiations leading to the award of a contract to manufacture, assemble and refurbish solid rocket boosters for the Space Shuttle. The $274 million cost-plus-incentive-fee contract, covering an approximate five year period, requires USBI to manufacture, assemble, check out and deliver 84 flights sets of solid rocket booster, and to refurbish them when returned to earth after each use. The contract includes two unpriced options, each for delivery of 60 flight sets, covering a total additional period of performance of about five years. Under a separate contract, USBI will build a new facility at Kennedy Space Center specifically for booster assembly and refurbishment. Cost of the new facility is estimated at $21 million. In the past, refurbishment has taken place at Kennedy's Vehicle Assembly Building — used to assemble the entire configuration of orbiter, boosters and external tank.

NASA has awarded a contract to an industry team headed by **RCA Astro-Electronics Division,** Princeton, N.J., for design, development and fabrication of the

Advanced Communications Technology Satellite (ACTS). Other major participants of the industry team are: **TRW Electronics Systems Group, Space Communications Division,** Redondo Beach, Calif.; **Communications Satellite Corp. (COMSAT),** Washington, D.C.; **Motorola, Inc., Government Electronics Group,** Scottsdale, Ariz.; **Hughes Aircraft Co., Electron Dynamics Division,** Torrance, Calif.; and **Electromagnetic Sciences, Inc.,** Norcross, Ga. ACTS, scheduled for launch by the Space Shuttle in 1989, will be used for advanced communications experiments. The $260.3 million contract is awarded with work tasks split among the several contractor facilities.

Lewis Research Center, Cleveland, Ohio, has awarded a $11.5 million cost-plus-award-fee contract to **W.L. Tanksley & Associates, Inc.,** Brook Park, Ohio. Effective July 23, 1984, the two-year contract calls for engineering design, drafting and fabrication services in support of aerospace hardware development related to new propulsion, power and communications technology. NASA has the option of renewing this contract for three one-year periods at $6 million per year, making the total contract worth $29.5 million. Specifically, the contractor will prepare sketches, layouts, detail drawings and fabrication work, where needed, of turbine engines; control consoles and electrical systems for power and data processing; flow systems for liquid and gaseous fuels, high pressure air and cryogenics; closed-loop automatic controls for regulating interactive hydraulic and pneumatic systems; dynamic space power systems, including the Stirling and Brayton energy conversion systems; and Space Shuttle mid-deck and payload bay flight experiments.

Lewis also has awarded a $6.5 million contract to **General Motors, Allied Division,** Indianapolis, for design, fabrication and test of a gearbox assembly to drive an advanced propfan. Under the three-year cost-shared effort, two full-size advanced technology gearboxes will be designed and tested for performance, power capability and endurance at the contractor's plant in Indianapolis. The propfan project is part of NASA's Advanced Turboprop Program, which addresses the critical technologies involved in applying fuel-efficient turboprop propulsion to aircraft operating in the Mach 0.65 to 0.85 range, typical of today's commercial jet transports.

The **Aerospace Technology Division,** Hampton, Va., of **Kentron International, Inc.,** Dallas, Texas, has been selected by Langley Research Center, Hampton, Va., for negotiation of a contract to provide technical support for aerospace research and development. Value of the three-year incentive-award-fee contract, beginning Oct. 1, 1984, will be approximately $38 million. Under terms of the contract to be negotiated, Kentron will provide technical support for most of Langley's aeronautics and space research programs, including low, transonic and highspeed aerodynamics; electronics and control systems; space systems and atmospheric sciences; acoustics and noise reduction, materials, loads and aeroelasticity, structures and dynamics; projects involving multidisciplinary aerospace systems; and systems and facilities engineering. Most of the work will be done at Kentron's Hampton technical center, with certain special jobs done at Langley.

Spacelab 3 Completes Mission Sequence Testing

Spacelab 3 moved a giant step closer to its scheduled January 1985 launch aboard the Space Shuttle with the successful completion in August of a major test series at the Kennedy Space Center, Fla.

"The week of testing represents one of the most important series of tests leading to the mission," said mission manager Joe Cremin of the Marshall Space Flight Center in Huntsville, Ala. "Everything went extremely well, I am very pleased with the performance of both the laboratory and the experiments."

The Integrated Mission Sequence Test, as the series is called, was designed to verify compatibility of experiments with each other and with their actual Spacelab support subsystems, added John Thomas, manager of the Spacelab Program Office at Marshall. It is the final major integrated test of the payload and laboratory prior to installation in the orbiter. Installation is now scheduled for December.

During the tests, Spacelab 3 science crew members in the Spacelab module worked with researchers in a simulated ground control center to operate the experiments just as they will do during the mission. Members of the Marshall Center Spacelab 3 mission management team were present at Kennedy for the testing, and representatives from both the Spacelab Program and Spacelab Payload Projects offices were on hand in Marshall's Huntsville Operations Support Center to monitor the testing.

Spacelab 3 is the first operational mission of the European-developed Shuttle-based research center. Its primary objective is to conduct application, science and technology experiments requiring the low gravity environment of earth orbit. The Marshall Center is responsible for managing this and several other Spacelab missions.

Astronaut Lenoir Leaves NASA

Astronaut William B. Lenoir has left the space agency to assume a position with the management consulting firm of Booz, Allen & Hamilton Inc., New York.

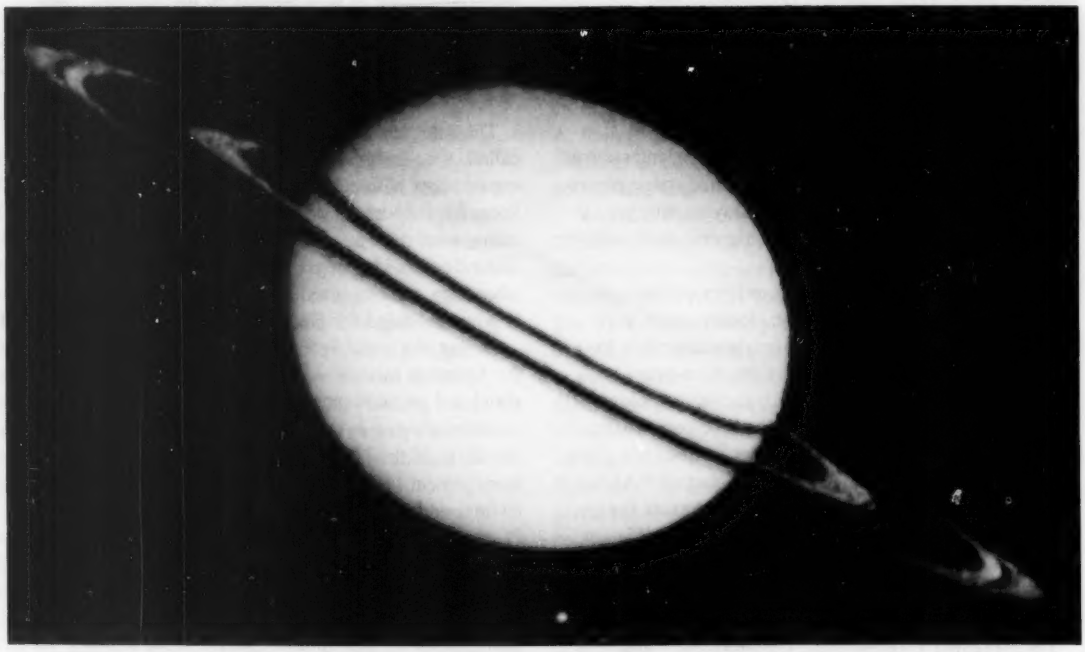
Lenoir, who has been an astronaut since 1967, will join the Space Systems Practice of Booz, Allen & Hamilton in Arlington, Va. The firm consults worldwide in management and technology and has been involved with the U.S. space program since 1963.

Lenoir will become a principal in the Space Systems Practice, working in the areas of systems development and commercialization of space.

Lenoir was a crew member on STS-5, the first operational mission of the Space Shuttle, in November 1982. During that flight, Lenoir served as the first in-orbit launch director for the deployment of a commercial communications satellite from the Space Shuttle. Since that time, he has been responsible for the direction and management of mission development within the Astronaut Office at the Johnson Space Center.

A graduate of the Massachusetts Institute of Technology with a bachelor's, master's and doctorate in electrical engineering, Lenoir was selected as a scientist-astronaut in August 1967. He served as backup science pilot for Skylab 3 and Skylab 4. During Skylab 4, he was co-leader of the visual observations project and coordinator between the ght crew and the principal investigators for the solar science experiments.

From September 1974 to July 1976, Lenoir worked on the NASA Satcllite Power Team, a group formed to investigate the potential of large-scale satellite power systems for terrestrial utility consumption.



Pioneer Saturn Fifth Anniversary — On Sept. 1, 1979, NASA's Pioneer spacecraft flew within 13,300 miles of Saturn. Pictured above is a view of the ringed planet from a distance of 1,500,000 miles, taken by Pioneer on Aug. 29, 1979, 58 hours before closest approach. The banded structure of the planet's cloud tops is quite evident. The silhouette of the rings can be seen against the lighted disk of the planet. Slightly above this silhouette is the shadow of the rings on the disk. Beyond the disk, structure can be seen in the rings. The outer A ring and inner C ring are bright and, between them, the B ring is dark. The Cassini Division at the inner edge of the A ring is clearly resolved and is bright. The A ring is dark just outside the Cassini Division because it has particular matter there. The satellite seen below the planet is Saturn's moon Rhea.

1984 Launch Activity

Space Shuttle Launches

Date	Mission	Orbiter	Launch Site*	Remarks
Feb. 3	41-B	Challenger (OV-099)	KSC	Payload: SPAS-01A, Palapa B-2, Westar-VI; successful launch; landing at KSC, FEb. 11.
April 6	41-C	Challenger (OV-099)	KSC	Payload: Solar Maximum Repair Mission; Long Duration Exposure Facility
Aug. 30	41-D	Discovery (OV-103)	KSC	Payload: LEASAT-1, Telstar 3-C, SBS-D, OAST-1; first flight of Discovery; successful.
Oct. 5	41-G	Challenger (OV-099)	KSC	Payload: OSTA-3, ERBS
Nov. 2	51-A	Discovery (OV-103)	KSC	Payload: MSL-1, Telesat-H, GAS Bridge
Dec. 9	51-C	Discovery (OV-103)	KSC	Payload: DOD Mission

Satellite Deployments from the Shuttle *

Date	Satellite	Deployment Device/** Upper Stage	Shuttle Mission	Remarks
Feb. 3	Westar-VI	PAM-D	41-B	Western Union communications; successful deployment from STS 41-B; satellite failed to achieve geosynchronous orbit.
Feb. 6	Palapa B-1	PAM-D	41-B	Indonesia communications: successful deployment from STS 41-B; satellite failed to achieve geosynchronous orbit.
April 7	LDEF	RMS	41-C	Long Duration Exposure Facility; successful deployment.
Aug. 30	SBS-D	PAM-D	41-D	Satellite Business Systems commercial communications
Aug. 31	Syncom IV-1	UUS	41-D	Hughes communications
Sept. 1	Telstar 3-C	PAM-D	41-D	AT&T communications
Oct. 1	ERBS	RMS	41-G	Earth Radiation Budget Satellite
Nov. 2	Telesat-H	PAM-D	51-A	Canadian communications

Expendable Launches

Date	Mission	Launch Vehicle	Launch Site	Remarks
March 1	Landsat 5	Delta	WSMC	National Oceanic and Atmospheric Administration; earth observation; successful launch.
June 9	Intelsat V-G	Atlas Centaur	ESMC	Intelsat international communications; satellite not in proper orbit due to Centaur stage malfunction.
Aug. 16	AMPTE	Delta	ESMC	Active Magnetospheric Particle Tracer Explorer; space physics — NASA cooperative with Germany; successful launch.
Sept. 21	Galaxy-C	Delta	ESMC	Hughes commercial communications satellite.
Oct. 18	NATO-IIID	Delta	ESMC	North Atlantic Treaty Organization communications.
November	NOAA-F	Atlas-F	WSMC	National Oceanic and Atmospheric Administration weather satellite.
4th Qtr.	AF-16 (ITV-1)	Scout	WFF	U.S. Air Force.
4th Qtr.	Navy 21	Scout	WSMC	U.S. Navy.
Under assessment	Intelsat VA-B	Atlas Centaur	ESMC	Intelsat international communications.

* **Launch Sites:** ESMC — Eastern Space and Missile Center, Fla.; KSC — Kennedy Space Center, Fla.; SMR — San Marco Range, Indian Ocean; WFF — Wallops Flight Facility, Wallops Island, Va.; WSMC — Western Space and Missile Center, Vandenberg Air Force Base, Calif.

** **Separation Device/Upper Stage:** IUS — Inertial Upper Stage; PAM-D — Payload Assist Module; RMS — Remote Manipulator System; UUS — Unique Upper Stage.

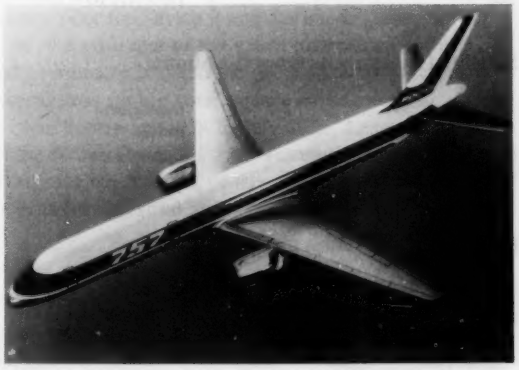
Another Dividend from Air and Space

Research and development in aeronautics and space have provided numerous benefits for all Americans—and at a tiny percentage of the tax dollar. Here is an example:

Aircraft Controls

United Technologies Hamilton Standard division, Windsor Locks, Connecticut, manufactures a broad line of aerospace, automotive and industrial equipment. Among the company's key products are electronic jet engine controls and digital flight controls. The engine controls are computerized systems that meter fuel in precise amounts and regulate a number of other functions to enhance engine performance, reduce fuel consumption, curb emissions and lower maintenance costs. An advanced type of engine control designed to provide utmost fuel efficiency makes its debut this year with the introduction to airline service of the Boeing 757 jetliner (right).

Hamilton Standard's digital flight controls are used on a number of military helicopters and some advanced fixed-wing aircraft, such as the Northrup F-20 fighter shown below. These controls employ motion sensors, electrical connections and on-board computers to actuate control surfaces instead of the conventional complex of rods and linkages; they provide fully automatic flight control and exceptional stability to enhance aircraft performance and maneuverability.



In predicting the reliability of these and other electronic systems, Hamilton Standard makes use of a computer program known as CARSRA, supplied by NASA's Computer Software Management and Information Center (COSMIC). With CARSRA, engineers can study a proposed design for a control system and predict whether each of its redundant (backup) units will operate acceptably; if not, improvements can be made in the design. CARSRA was selected to provide increased flexibility over previous techniques. After determining that CARSRA was an accurate, flexible tool, Hamilton Standard used the best features of the COSMIC software to develop an advanced reliability modeling technique.

* NASA does not endorse commercial products developed as a result of its Technology Utilization or Patent Licensing Programs, but it does encourage the widest possible use of its technology.

NASA
National Aeronautics and Space Administration